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Soil Fertility Due to The Use of Inorganic Fertilizer In Batu Merah Village, Lampihong District

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Abstract

The use of inorganic fertilizers in the short or long term to paddy soil can affect it as a source of soil nutrient availability. Knowing the status of soil fertility is for determining soil fertility status aimed at assessing soil characteristics and determining the main constraints of soil fertility for farming, determined by the physical, chemical and biological properties of the soil. Artificial (inorganic) fertilizers are fertilizers made in factories, inorganic fertilizers are formed by chemical processes. Inorganic fertilizers have advantages such as, made precisely and the administration can be adjusted. However, not all inorganic fertilizers contain complete elements (macro and micro), the administration can be combined with micro fertilizers and organic fertilizers. The method used in this research is descriptive quantitative. Soil sampling and analysis was carried out in March 2022, carried out diagonally at 5 sample points on the respondent's land, as many as 10 Siam Mutiara rice farmers, so that 50 sampling points were obtained. with an average land area of approx. (± 9.7 ha). The data obtained is presented in the form of tables or figures, then the data is described. The results of the analysis of the parameters of the chemical properties of the soil at the Laboratory of the Department of Soil Science, Faculty of Agriculture, University of Lambung Mangkurat, show the value of soil acidity (pH), acidic to very acid (3.95 - 4.89), C-organic (5.18%) - 15.52 %) is moderate to high. N-total (0.47% - 0.69%) value is moderate to high. P-total (12.48 mg/100 g - 118.83 mg/100 g) was rated very low to very high, and the K-total value (15.44 % - 43.05 %) was rated low to high.

Keywords: Soil fertility, Inorganic Fertilizers, Soil Chemical Properties

Introduce

Soil fertility is the ability of a soil to provide nutrients, at certain levels and in a certain balance on a sustainable basis, to support the growth of a type of plant in an environment with other growth factors in favorable conditions. Soil fertility is one of the determinants of results in terms of quality and quantity. Soil fertility is the quality of the soil for growing crops, determined by the physical, chemical and biological properties of the soil. The diversity of soil composition, especially soil chemistry, is able to support agricultural commodities with the availability of nutrients in the soil so that there is soil that is called fertile soil and vice versa [1].

Fertilization needs to be done to replace the loss of nutrients in the soil due to leaching and aims to meet the nutrient needs of plants so that they can increase plant productivity [2]. The chemical properties of soil are also closely related to fertilization activities. Knowing the chemical properties of soil means getting an idea of the type and amount of fertilizer needed. Knowledge of the chemical properties of soil can provide an idea of fertilizer dosage and the reaction of fertilizer after it is applied to the soil [3].

Soil acidity (pH) is a soil reaction that plays a role in the solubility of soil nutrients. Low soil acidity will cause plants to be unable to utilize the N, P, K and other nutrients they need. Low acidity also causes the availability of toxic elements such as aluminum which always poisons plants and also binds phosphorus so that it cannot be absorbed by plants [4]. Soil acidity is an indicator of soil fertility, because it can reflect the availability of nutrients in the soil. Soil reactions indicate the acidity or alkalinity of the soil which is expressed by the pH value [5].

The C-organic content is part of the soil which is a complex and dynamic system, which originates from plant or animal remains in the soil which continuously change shape. Soil organic matter is all the carbon in the soil that comes from the remains of dead plants/plants and animals [6]. Different sources of organic material will have different effects on the organic material contributed to the soil. The organic matter content reflects soil quality which directly or indirectly influences soil quality because of its influence on physical, chemical and biological indicators of soil quality [7]. Nutrients N, P and K. The availability of these nutrients is determined by two factors, namely innate factors and dynamic factors. Innate factors are soil parent materials, which influence soil order. Dynamic factors are changing factors, including irrigation, fertilization and the return of plant litter [8]. The element N is one of the elements needed in the largest quantities so it is called a primary macro nutrient. The N element is absorbed by plants in the form of ammonium ions (NH_4^+) or nitrate ions (NO_3^-). N functions to compile amino acids (protein), nucleic acids, nucleotides and plant chlorophyll and accelerate plant growth [9]. The element P (phosphorus) is also a primary macro nutrient so plants need it in large quantities to grow and produce. Plants take up the element P from the soil in the form of $H_2PO_4^-$ ions. The concentration of element P in plants ranges from 0.1 - 0.5%, lower than elements N and K. The presence of element P functions as energy storage and transfer for all plant metabolic activities, with the presence of element P plants will experience benefits such as, forming a good root system, as well as encouraging the formation of flowers and ripening of fruit and seeds [10]. The phosphorus element in soil comes from organic matter and soil minerals. Lack of P elements will hamper plant growth, such as leaves and fruit falling off prematurely. The level of potassium (K), an element that is easily mobile, is easily lost from the soil through leaching, because K is not held firmly by the surface of soil colloids. and is easily lost from the soil causing low efficiency. The process of plant growth, the K element is one of the primary macro nutrients that plants need in large quantities, in addition to the elements N and P. The K element is absorbed by plants from the soil in the form of K^+ ions. The benefits of element K for plants include, as an enzyme activator, around 80 types of enzymes whose activation requires the element and helps plants absorb water and nutrients from the soil [10]. The efficiency of potassium absorption means fertilization measures are very necessary.

Fertilizer is a material that can increase soil fertility because it contains one or more nutrients [11] Inorganic fertilizers are essential elements for plant growth at both high and low levels. but it can also be in the form of a mixture that provides ionic forms of nutrients that can be absorbed by plants. To support normal plant growth, a minimum of 16 elements are required, of which there are 3 absolute elements, namely nitrogen, phosphorus and potassium [2].

This fertilizer is not obtained in nature, but is the result of a factory concoction. Because inorganic fertilizers are made by humans, their nutrient content can vary and be adjusted to suit plant needs. The advantages of inorganic fertilizers include that the nutrient content in inorganic fertilizers is made precisely and the application can be adjusted to suit plant needs. This fertilizer also has a weakness, namely that not all inorganic fertilizers contain complete elements (macro and micro). In fact, some only contain one element. Therefore, the application must be accompanied by microfertilizer and/or compost. Apart from that, the use of inorganic fertilizer must also be wise, if it is used incorrectly, it can trigger water pollution and disrupt the ecosystem within it. It must also be in accordance with the recommended dosage and not excessive, because if excessive it can cause the plants to die [9]. Lampihong District, for example, has a flat physical character, without undulating areas that affect soil fertility factors. General description of the quality of soil fertility in Lampihong District is not optimal [12]. The majority of farmers still do not apply modern agricultural technology such as the use of balanced fertilizer, so the impact is that crop production, especially rice, cannot be maximized [13]. And still using a hereditary farming system Based on the description above, research was carried out with the aim of finding out soil fertility resulting from the use of inorganic fertilizer in Batu Merah Village, Lampihong District.

MATERIALS AND METHODS

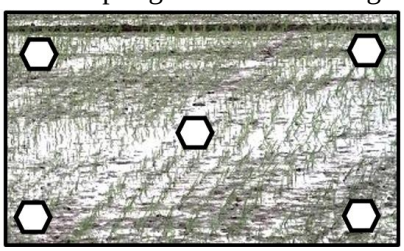
The method used in this research is quantitative descriptive. Research includes field and laboratory activities. Field activities were for taking soil samples, while research soil analysis was carried out at the Soil Science Department Laboratory, Faculty of Agriculture, Lambung Mangkurat University. The data that has been obtained is presented in the form of tables or images, then the data is described.

The materials used in this research were as follows, soil samples, chemicals, Urea fertilizer, SP-36 fertilizer, NPK fertilizer, and lime. The tools used in this research were as follows, pH meter, scales, modified soil drill/pipe, paper labels, plastic clips, field equipment, laboratory equipment, stationery, camera/open camera.

The method used in this research is descriptive quantitative research. Soil sampling was carried out diagonally at 5 sample points on the respondent's land in the field as many as 10 Siam pearl rice farmers, so that 50 sampling points were obtained. Then composites were carried out for analysis in the laboratory, so that 10 soil samples were obtained. Each time a soil sample is taken, the coordinates are recorded using the Open Camera application. The data that has been obtained is presented in the form of tables or images, then the data is described.

Implementation of this research began with a research field survey. The survey was conducted to find rice farmers who use inorganic fertilizers on their rice fields in Batu Merah Village, Lampihong District, Balangan Regency, and examine the relationship between soil fertility and rice production due to the use of inorganic fertilizers, with the following criteria:

a. Conduct a survey of 10 rice farmers who use inorganic fertilizer in their farming business.
b. The total area of land studied was around (± 9.7) ha.
c. Soil sampling is carried out diagonally.



d. Taking soil samples for soil analysis in the laboratory with observation variables, (pH) soil acidity, soil organic C, and total N, P and K elements in the soil, with the following stages:
    1. Prepare tools and materials that will be used during research.
    2. Determine soil sampling points or plots in rice fields.
    3. Take pictures/photos when sampling at the sampling location using the Open Camera application to get the coordinates of the sampling location.
    4. Soil sampling was carried out at 5 points in each field, so that 50 points were obtained. Then a composite was carried out from five soil samples in one field, so that 10 soil samples were obtained for laboratory analysis.
    5. Soil samples are taken using a modified pipe/soil drill at a depth of 0 to 20 cm, approximately ± 1 kg of soil at each soil sampling point.
    6. Soil samples are put into sample plastic and labeled which will then be taken to the laboratory for analysis.
    7. The sample code SR (Soil Ricefield) 1 to 10 is given to each sample of farmer's land.
        - SR 1, titik koordinat : -2^{o}22’17”, 115^{o}22’43”
        - SR 2, titik koordinat : -2^{o}22’16”, 115^{o}22’48”

- SR 3, titik koordinat : -2°22’15”, 115°22’46”
- SR 4, titik koordinat : -2°22’17”, 115°22’43”
- SR 5, titik koordinat : -2°22’20”, 115°22’39”
- SR 6, titik koordinat : -2°22’13”, 115°23’50”
- SR 7, titik koordinat : -2°22’11”, 115°22’46”
- SR 8, titik koordinat : -2°22’13”, 115°22’49”
- SR 9, titik koordinat : -2°22’12”, 115°22’49”
- SR 10, titik koordinat : -2°22’12, 115°22’49”

8. Adapun yang menjadi parameter pada penelitian ini yaitu, pengamatan status kualitas kesuburan tanah sawah yang diamati meliputi : (pH) Soil acidity (Electrodes in a ratio of 1:5), C-organic (Wakley & Black Method), N-total (Nitrogen) (Khejeldhal Method), P-total (Phosphorus) (Spectrophotometric Method), & K-total (Potassium) (Flamephotometer Method).

Data processing. The research data is tabulated in the Microsoft Excel 2010 application, then presented in the form of images or tables. Next, data on rice production and soil fertility were interpreted.

Result and Discussion

Soil acidity (pH)

Soil acidity (pH) is a soil reaction that indicates the acidity or alkalinity of the soil. Soil pH plays a role in determining whether or not nutrients are easily absorbed by plants. Based on the results of soil sample analysis in the laboratory, the effect of applying inorganic fertilizer on resistant acidity (pH) in Batu Merah Village, Lampihong District, Balangan Regency, with the highest pH being SR 7 = 4.89 and the lowest being SR 3 = 3.95 which has information sour to very sour (Figure 1).

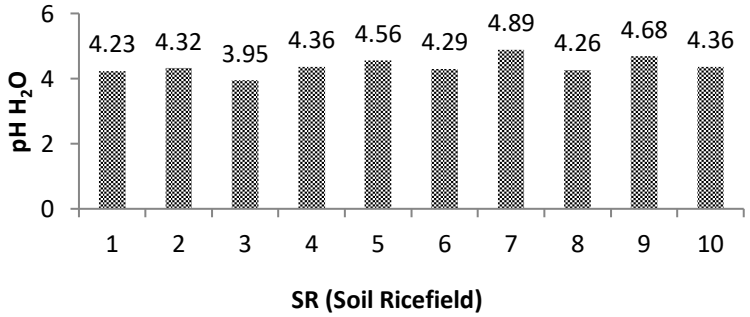


Figure 1.
Soil pH (H_2O) Value with the Use of Inorganic Fertilizer

The appropriate soil pH for rice plants, ranges from 5 - 6.5. This is because the management of inorganic materials given by farmers to rice fields has not been balanced [14]. Apart from that, the soil acidity (pH) value is acidic to very acidic due to the use of inorganic fertilizer which is acidic and not accompanied by the provision of organic material in the form of compost or straw. Soil pH shows that all rice field soil samples fall into unhealthy criteria because their pH values fall into the acid to very acid category. This is in accordance with the statement of [15], that soil with a pH ranging from 4.5–6.5 is soil with unhealthy criteria. Farmers in Batu Merah Village, Lampihong District, Balangan Regency, generally rely on rainfall to drain their rice fields, the drainage process which should be useful for bringing water in and out of the rice fields is not functioning well [16]. High rainfall intensity also causes nutrients in the soil to be leached, making the soil more acidic.

C-organic

Based on the results of soil analysis in the laboratory, the organic matter content of soil in farmers' land in Batu Merah Village, Lampihong District, ranges from 5.18% (SR 4) to 15.52% (SR 1), which is medium to high. According to [17], the minimum C-organic value in the soil can be approximately 2% of the organic matter in the soil to be stable. The C-organic content in the study area is classified as medium - high. This is thought to be due to the return of organic material in the form of straw and plant residues around the research area.

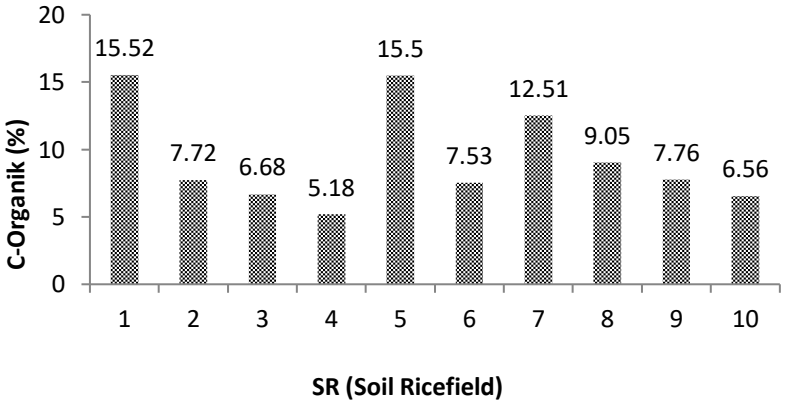


Figure 2.
C-organic value using inorganic fertilizer

Based on the analysis in (Figure 2), the C-organic content at the research location has been managed better by returning organic material sources, so that the C-organic content in the soil is sufficient. Low organic C content (< 2%) in intensified rice fields will have implications for decreasing soil fertility and fertilizer efficiency [18]. The large amount of organic material causes the color of the soil to become brown to black, usually black soil is fertile soil. The level of organic matter also affects the number and metabolic activity of soil organisms. Increasing the activity of soil organisms will accelerate the decomposition of organic matter into humus. The C-organic content in the research area is classified as moderate to high, possibly due to the farming system which is carried out intensively by giving back sources of organic materials such as rice straw. The status of c-organic content at the research location is thought to support the growth of rice plants.

N-total

Soil nitrogen content varies greatly and is influenced by other factors such as vegetation and the physical and chemical properties of the soil. Based on the results of analysis of soil laboratory samples in Batu Merah Village, the N-total value SR 10 = 0.47 to SR 9 = 0.69% was obtained (Figure 3).

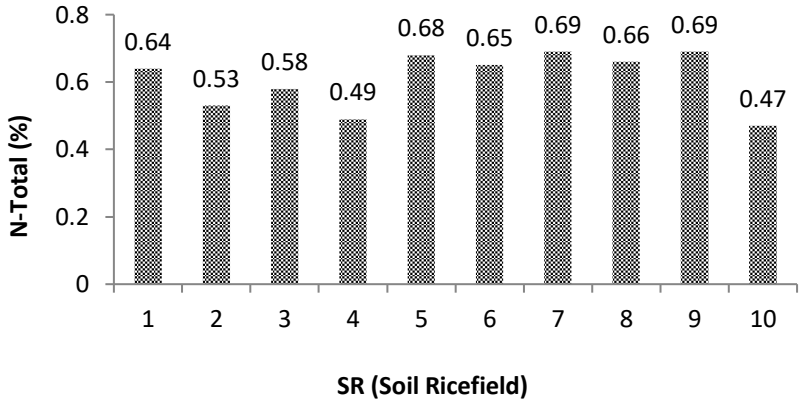


Figure 3.
Soil N-total value using inorganic fertilizer

Nitrogen availability at the research location is predominantly in the high category, except for sample codes SR 4 & SR 10 which are in the medium category. The amount of N in the soil depends on environmental conditions such as climate, as well as the type of vegetation growing and the speed of its decomposition, which are factors that cause changes in the N content in the soil. The total N content at the research location was classified as moderate to high. This can happen because in the rice fields at the research location, farmers usually rotate crops, tending to use organic materials such as manure alternately, namely when planting types of vegetable crops. The use of organic fertilizer has an indirect impact on soil fertility so that it experiences changes in its physical, chemical and biological properties, especially with an increase in the nutrient N. However, the process of N loss can also be caused by some of the N being transported during harvest through the crop or lost through washing (*leaching*). Apart from that, some of the N nutrients are also returned as plant residues [20-22].

P-total

Based on the results of soil P-total analysis (P_2O_5) in the laboratory, the result of the use of inorganic fertilizer in Batu Merah Village, Lampihong District, Balangan Regency with criteria for very low to very high values with a value of 12.48 – 118.83 mg/100 g (Figure 4). The total P content criteria are very low in the sample code SR 10, while it is very high in the sample code SR 5.

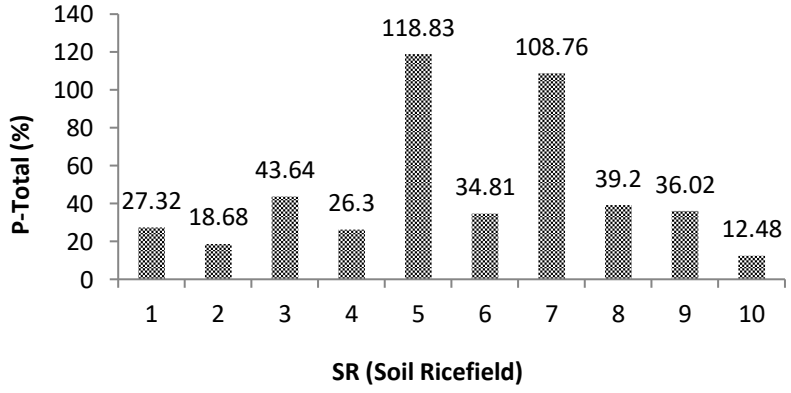


Figure 4.
P-total value of soil using inorganic fertilizer

The low total P condition is thought to be due to the leaching of P nutrients in the soil. This is because the P element is an unstable element in the soil. Apart from that, low total P can also be caused by high soil acidity so that the solubility of Al and Fe becomes higher. The high content of

metal cations causes soil P to be unavailable due to strong bonds in the form of Al-P or Fe-P. The availability of P in soil is closely related to soil acidity (pH) [23]. The bond formed by the nutrient P with metal cations is very difficult to remove, thereby preventing plants from absorbing the element P in the root area. The mineralization process tends to be high so that total P is in the medium to high category, however, high levels of leaching and fixation result in low dissolved P available to plants [24]. The soil pH balance system is one of the factors that influences the availability of available P elements in the soil, low pH causes the availability of available P elements to become lower [25]. Apart from that, the low total P in paddy fields is thought to be caused by planting patterns and the use of inorganic fertilizers that are not in appropriate doses [24].

K-total

The results of laboratory analysis show that the potassium content of the soil from research in Batu Merah Village, Lampihong District, Balangan Regency shows that the K-total of the soil ranges from 15.44 - 43.05 mg/100 g, which is classified as low to high. The highest K-total content was found in sample code SR5, while the lowest was found in sample SR 2.

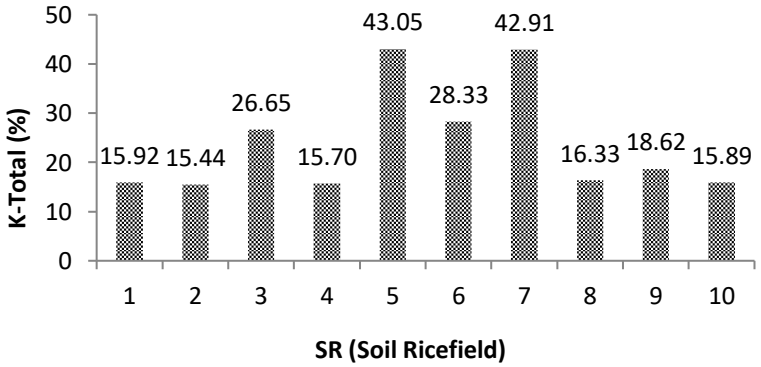


Figure 5.
Soil K-total value using inorganic fertilizer

The cause of high and low levels of soil potassium (K-total) at the research location was influenced by soil pH. Acidic soil pH causes increased potassium fixation, thereby reducing the availability of element K in the soil. The K nutrient is sensitive to leaching and is fixed or adsorbed in the lattice of mineral cavities. The K_2O content in the soil is determined by the conditions of soil formation and development, old soils tend to have low K nutrients. Total K in the soil can also be influenced by the mineralization process of mineral materials or organic materials [6]. In addition, the response of plants, especially rice, to K fertilization is generally low because K needs can be met from K mineral reserves which are balanced with K in the soil solution, thereby increasing available K. Temperature causes potassium absorbed in soil minerals to be released thereby increasing nutrient availability [25] [26].

Conclusion

Quality of soil fertility due to the use of inorganic fertilizers on rice fields in Batu Merah Village, Lampihong District, South Kalimantan. Parameter analysis (pH) of soil acidity in the acid - very acid category, with a value of (4.89 - 3.95), C-organic in the medium - high category, with a value of (5.18% - 15.52%), levels total nitrogen (N) in the medium - high category, with a value of (0.47 % - 0.69 %), total phosphorus (P) content in the very low - very high category, with a value of (12.48 - 118.83 mg /100 g), total potassium (K) levels are in the low - high category, with a value of (15.44 – 43.05 mg/100 g). Therefore, it is necessary to add agricultural lime according to a certain dose to regulate (soil pH), and the application of inorganic fertilizer at a certain dose is expected to

have an impact on improving the chemical properties of the soil and soil fertility in general, so that it can have a maximum effect.

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